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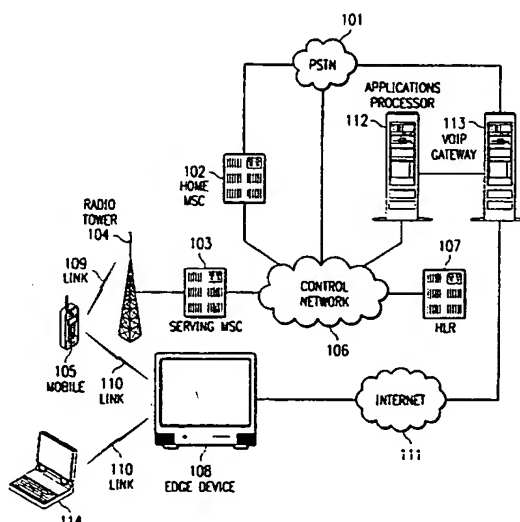
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(54) Title: **SHORT HAUL RADIO SUPPORTED WIRELESS COMMUNICATIONS**



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(57) Abstract: A system that allows wireless devices, such as mobile phones, pagers or PDAs, equipped with short haul radio in addition to normal cellular or PCS frequencies to register, originate and receive calls through a computer network or the Internet. Short haul radio systems may use Bluetooth or HomeRF protocols. When the wireless device comes within range of an edge device in the short haul network, the wireless device detects the presence of the edge device and switches to the frequencies used by the short haul system. The edge device converts signals from the short haul radio to a format compatible with the computer network. An application processor on the computer network interfaces with the wireless network's signaling and control network to allow the mobile to register on the wireless network. Incoming calls to the mobile are then under the control of the application processor, which causes calls to be routed to the edge device through an associated gateway. Outgoing calls are routed through the edge device to the gateway into the PSTN.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SHORT HAUL RADIO SUPPORTED WIRELESS COMMUNICATIONS**TECHNICAL FIELD**

The present invention is related to wireless communications and, more particularly, to the cooperative interaction between conventional wireless telephone
5 networks and short haul radio networks, such as Bluetooth networks.

BACKGROUND

As wireless usage increases by consumers, service rates, and, therefore, the revenue per user, are forced lower by competitive pressure. It has long been recognized that different rate structures could be offered to wireless users if a more efficient network could be used by the subscriber in certain instances. One attempt at a more efficient network has been the wireless industry's attempt to implement small radio base stations in the home. These home base stations would allow wireless telephone users to register with the wireless telephone network by establishing a voice channel through the base station, which would be connected to the wireless network through the users home telephone line. This would reduce the traffic on the generally available wireless frequencies that are used by the wireless system's macro and micro cells. However, this system has certain limitations since the wireless service provider has to provide a home base station to users. Also, since the home base station uses the local wireline connection, the users' home telephone lines are not available when the users make wireless calls from the home. As a result, this system requires additional costs, complexity and higher home telephone line use.

Alternative systems and methods for routing voice and telephone signals are being developed as replacement for transmission over traditional wireline connections. For example, use of the Internet to send voice signals is a developing technology. Voice signals may be transmitted across the Internet, or any other computer network, using the Voice over Internet Protocol (VoIP). This technology allows voice signals to be delivered as packets of data using the Internet Protocol (IP). In general, this means sending voice information in digital form in discrete packets rather than in the traditional circuit-switched protocols of the Public Switched Telephone Network (PSTN). A major advantage of VoIP and Internet telephony is that it avoids the tolls charged by ordinary telephone service and may be less expensive to provide.

VoIP generally derives from the VoIP Forum, an effort by major equipment providers, to promote the use of ITU-T H.323, the standard for sending voice (audio) and video using IP on the public Internet and within private intranets and networks. VoIP

uses the Real Time Protocol (RTP) to help ensure that audio packets get delivered in a timely way. It is currently difficult to guarantee quality of service for Internet calls over the existing Internet connections. Better service is possible through private networks managed by an enterprise or by an Internet Telephony Service Provider (ITSP). To use voice over IP, a VoIP device, such as an access server with the VoIP feature, is positioned as a gateway. The gateway receives packetized voice transmissions from users and then routes them to other users over an intranet, such as a Local or Wide Area Network(LAN/WAN) or, using a T-1 or E-1 interface, sends them over the PSTN.

VoIP capabilities have improved to the point where it is now reasonable to use the Internet or other computer networks to handle voice calls. A key requirement for successful VoIP deployment is the capability of the underlying IP-based network. The Internet continues to expand and has begun to move into the home environment through a number of methods, such as the use of cable television systems to access the Internet. Cable television or community access television (CATV) brings television programming to millions of homes throughout the world. Additionally, CATV is an increasingly popular way to interact with the World Wide Web and to access other forms of multimedia information and entertainment services. CATV service providers have begun to offer support for high speed Internet access connections in the home. These CATV Internet connections provide a much higher bandwidth than what is available from a traditional wireline telephone connection to the home.

Other technologies are being developed to provide improved wireless data connections between devices within homes and businesses. Short haul radio systems, such as Bluetooth or the HomeRF Shared Wireless Access Protocol (SWAP), are examples of systems that can provide local computer network access via wireless connections. These projects use the unlicensed 2.4 GHz spectrum to establish localized voice and data connections. These short haul radio systems can be used to link multiple devices within a short range.

Bluetooth is a microchip-based technology with protocols that enable wireless digital communication between disparate electronic products. Instead of using

proprietary cable connections or other wireline connections, Bluetooth uses a universal short-range radio link to link two or more devices in an ad hoc network. A group of devices connected via Bluetooth technology is called a piconet. The Bluetooth-capable devices are peer units in that all units implement the RF, Baseband and Link Manager network layers. A piconet may contain up to eight active devices in which one device acts as the Master and the other devices act as Slaves. The Master device is simply a unit in the piconet to which the other, Slave units synchronize.

Bluetooth uses a pseudo-random hopping frequency schedule through 79 RF channels. The typical transmission power for a Bluetooth device is 1 milliwatt, which gives the devices a normal transmission range of approximately 10-100 meters. One of the existing attributes of Bluetooth is that two devices with this technology can be set to automatically recognize each other when they are close together. General and specific inquiry messages are used by Bluetooth-capable devices to discover either all or a particular class of nearby Bluetooth devices. Upon receipt of an inquiry message, a device will broadcast its device address, access code and its clock information.

When a device does not have a connection, it monitors the RF channels in accordance with its own hopping schedule for access request messages. To establish a connection to another device, the Master unit must determine the Device Address of the other device to determine the proper hopping schedule. In addition, access requires knowledge of the Slave unit's Device Access Code (DAC). The Master unit transmits a train of DACs at different hop frequencies. When a Slave unit detects its DAC, it signals a page response at the same hop frequency as the page signal. The Master unit then transmits a Frequency Hop Synchronization (FHS) packet including the Master unit's clock, device address and device class. The Slave unit acknowledges the FHS and then the Master unit begins sending traffic packets.

Communication between Bluetooth devices is controlled by several protocols. The link manager protocol defines procedures for connection management activities, such as authentication, encryption, mode, quality of service and link type selection. The telephony protocol defines procedures and messaging for call control and signaling

functionality. The Bluetooth specification supports 64 kbits/sec mu-law and A-law logarithmic PCM voice encoding and 64 kbit/sec Continuous Variable Slope Delta Modulation (CVSD).

5 The HomeRF SWAP system operates as either an ad hoc network or as a managed network under the control of a Connection Point. In an ad hoc configuration, control of the network is distributed among the participating stations. For time critical applications, such as interactive voice, a Connection Point is required to coordinate the system. The Connection Point provides a gateway to the PSTN and can support both voice and data services.

10 It is an object of the present invention to provide a system and method in which wireless telephones can communicate with conventional wireless networks and with short haul radio systems.

15 It is a further object of the invention to allow wireless telephones to easily shift between the conventional wireless networks and the short haul networks depending upon user location, thereby reducing the traffic load on the wireless network and improving the services offered by the short haul radio network.

SUMMARY OF THE INVENTION

These and other objects, features and technical advantages are achieved by a system and method in which wireless devices monitor the availability of short haul radio networks and register on the short haul networks when one is detected. The short haul
5 radio network may comply with the Bluetooth, HomeRF or other protocol or standard. The wireless devices that use the present invention may include wireless telephones, wireless modems, pagers, and the like.

The wireless devices are equipped with short haul radio functionality in addition to normal cellular or PCS functions and are capable of communicating over short haul
10 radio frequencies, such as the 2.4 GHz band, in addition to conventional wireless and cellular frequencies. The short haul radio network is connected to the Public Switched Telephone Network (PSTN) or to the wireless network through a computer network or the Internet. The wireless device can register with the wireless network and originate and receive calls through the computer network.

15 When the wireless device comes within range of a short haul radio network edge device, the short haul radio detects the presence of the edge device and switches to the short haul radio network frequencies. The wireless device establishes a connection with the edge device, which then converts signals from the wireless device to a format compatible with the computer network. Signals from the wireless device may then be
20 routed to other devices or servers on the computer network.

In one embodiment, an application processor on the computer network provides an interface with the wireless network. The application processor allows the wireless device to register on the wireless network. The wireless network updates the device's location and sends information to the wireless device via the applications processor and the
25 computer network.

Incoming calls to the wireless device are routed under the control of the application processor. A VoIP server or gateway may be associated with the applications processor to facilitate routing voice calls to the device. When the wireless device is

registered on the short haul network, outgoing calls are routed through the edge device to a gateway into the PSTN.

The present invention provides a system and method for establishing wireless communications with a wireless device that is capable of communicating with both a wireless network and a short haul network. The wireless device may be a wireless or cellular telephone, a pager, Personal Digital Assistants (PDA), wireless modem or the like. The wireless device detects an edge device in a short haul radio network and establishes a communications link between the wireless device and the short haul network. The existing communications links between the wireless device and the wireless network are courtesy terminated, and the wireless device registers with the wireless network as active on the short haul network through an applications processor that couples the short haul network and connected VoIP network to the wireless network. The short haul network may comply with the Bluetooth protocol or any short haul communications protocol. The wireless device communicates with the edge device using the Bluetooth protocol or other short haul protocol as appropriate.

If the communications link between the wireless device and the short haul network is terminated, then the wireless device establishes a communications link with the wireless network and registers with the wireless network as active on the wireless network. The edge device may be any device that is capable of using the short haul network protocol, such as a personal computer, a WebTV device or any Internet or computer network device or appliance.

When the wireless device is in communication with and registered on the short haul network, call setup messages from the wireless network may be directed to the short haul network for calls directed to the wireless device. Call connections between the wireless network and the wireless device may be established to allow voice or data communications between the wireless device and a caller or device. Likewise, the wireless device can initiate calls, so that the wireless network receives call setup messages for calls initiated by the wireless device on the short haul network. The wireless network

or an application processor establishes call connections between the wireless network and the wireless device to complete calls initiated by the wireless device.

The present invention further provides a system and method for coupling a computer network to a wireless network, wherein the computer network is coupled to a short haul radio network. The system comprises a device for receiving registration messages from the short haul radio network, such as an intelligent network node, a processor, a server or the like. The registration messages are received via the computer network and have a format that is adapted for transmission over the computer network. The registration messages from the computer network are typically converted to a different format that is adapted for the wireless network. These converted registration messages are then sent to the wireless network.

The system also includes a device for establishing a voice call connection between the wireless network and wireless devices that are active on the short haul radio network. In order to support the call connections, a converter device converts voice communication signals on said wireless network to a format that can be transmitted across said computer network to said short haul network. This device may convert packet-based messages on the computer network to IS-41 messages on the wireless network or Intelligent Network Application Protocol (INAP) messages on the PSTN in order to set up the call connections and route calls between the networks.

Voice communication signals are converted between PCM or compressed signals on said wireless network and packet-based signals on said computer network and then to the format used by the short haul radio. The system may also comprise means for converting voice communications signals between a packetized voice format used by the wireless telephone and the packet-based signals on said computer network. In another embodiment, the means for converting voice communications signals does no conversion and, instead, encapsulates the message for transmission through the computer network and short haul radio link to the wireless telephone. In other embodiments, no conversion is required and the signal is transmitted directly to the wireless telephone. The packet-based signals may be Voice over Internet Protocol (VoIP) signals.

The wireless network may comprise an HLR and a means for communicating with the HLR allows the wireless telephone to register on the short haul radio network. The means for communicating with an HLR may be a processor, a server or the like, and further comprises a means for updating a current location of the wireless telephone. The computer network may be connected to the wireless network as a functional entity of the wireless network, such as a functional entity defined in the IS-41 standard. Such a configuration enables the wireless network to interact with the computer network and to provide local mobility and profile information to the computer network. The means for connecting the computer network to the wireless network can also operate to allow the computer network to function as a MSC on the wireless network.

The invention also provides an apparatus for integrating a wireless network to a computer network. The wireless network has a protocol that facilitates interaction among network elements and provides enhanced and customized services to wireless devices. The computer network has a protocol that facilitates transmission of signals across the computer network. A device, such as processor, computer or the like, translates signals from the wireless network protocol to the computer network protocol and from the computer network protocol to the wireless network protocol. The apparatus also exchanges messages with the wireless network and with wireless devices that are active on a short haul radio network extension of said computer network. The wireless network protocol may be an IS-41 protocol and the computer network protocol may be a packet-based protocol. INAP messages may also be exchanged with the PSTN. Registration messages are received from the wireless devices that are active on the short haul radio network and translated to registration messages for the wireless network. The wireless devices that are active on the short haul network are registered with an HLR on the wireless network. Call connections may be established between the wireless network and the wireless telephones that are active on the short haul radio network. A VoIP gateway converts between voice signals on the wireless network and packet-based voice signals on the computer network to allow voice calls to be completed from the wireless network to the wireless devices on the short haul network.

The present invention also provides a wireless device that is capable of communicating with both a wireless network and a short haul radio network. The wireless telephone comprises circuitry and associated software, such as microprocessors, digital signal processors, Application Specific Integrated Circuits (ASIC) and the like.

5 The wireless telephone is capable of establishing a communications link with and registering on a wireless network that complies with any applicable wireless standard. The wireless telephone also has the capability of establishing a communications link with and registering on a short haul radio network. These features allow the wireless device to register on either type of network independently. The wireless telephone may be in

10 communication with only one type of network or with both the wireless and short haul networks at the same time. The wireless telephone can detect edge devices on the short haul radio network while still registered on the wireless network.

When the wireless telephone registers on the short haul network, registration messages are sent to the wireless network when the communications link is established

15 between the wireless device and the short haul network. The communications link with the wireless network may be maintained while the wireless telephone sends registration messages over the short haul radio network. In this embodiment, the registration messages sent on the short haul radio network are used to update the wireless device's location in a database on the wireless network. This allows the wireless device to

20 maintain communication through the wireless network while using more accurate location information from the short haul network.

The wireless device may move between short haul networks. The wireless telephone may have the capability to detect a second short haul radio network while in communication with a first short haul radio network. The wireless telephone moves from

25 the first short haul network to the second by completing a handoff between the networks.

It is an advantage of the present invention to provide wireless communications, including voice communications, through a short haul network. The voice communications may be incoming calls routed to a wireless telephone that is registered on the short haul network and associated computer network. Additionally, the voice

communications may be outgoing calls routed from the wireless device to the PSTN through the short haul network edge device, a computer network and a PSTN gateway.

It is another advantage of the present invention to provide an applications processor that allows a VoIP gateway to the short haul network to function as an extension of a wireless network, such as a Mobile Switching Center or Home Location Register (HLR).

It is a further advantage of the invention to provide an applications processor that converts messages from a wireless network format to a computer network format, thereby allowing messages to be exchanged between the two networks.

Another advantage of the present invention allows a wireless telephone to register with a database in the wireless network while the telephone is in communication with a short haul network, thereby allowing the wireless telephone to access the services available in the wireless network.

The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

5 FIGURE 1 is a diagram of a system embodying the present invention;

FIGURE 2 is a diagram of an alternative embodiment of the present invention;

FIGURE 3 illustrates messages that are exchange during an outgoing call from a wireless device using the present invention;

10 FIGURE 4 illustrates messages that are exchanged during an incoming call to a wireless device using the present invention; and

FIGURE 5 illustrates messages that are exchanged during an incoming call to a busy wireless device using the present invention.

DETAILED DESCRIPTION

Figure 1 illustrates an exemplary embodiment of the present invention. Wireless telephone 105 communicates through wireless link 109 with an antenna at base station 104. Such communication is well known in the art and is employed in cellular, PCS and other wireless networks throughout the world. Base station 104 and other base stations (not shown) are connected to, and controlled by, MSC 103. Wireless control network 106 links MSC 103 with other MSCs and other network components, such as MSC 102 and HLR 107. These network components communicate with each other and exchange information through wireless network 106 using, for example, messages defined in Interim Standard (IS) 41 or GSM MAP.

The wireless network may be any wireless network, such as wireless telephony networks complying with the Global System for Mobile communications (GSM), Digital-Advanced Mobile Phone Service (DAMPS), Interim Standard (IS) 136, IS 95 standards; or any other Personal Communications Services (PCS) wireless network. Components of the wireless network are coupled to PSTN 101, either directly or through control network 106. The term "wireless network" as used herein refers generally to typical infrastructure and components of a wireless network, such as base station 104, MSCs 102, 103, HLR 107, switching and control network 106 and any other related nodes or elements, including Visitor Location Registers (VLR), Signaling Control Points, message centers and the like.

Applications Processor 112 is connected to the wireless network through control network 106. Applications Processor 112 is also connected to VoIP Gateway 113. U.S. Patent No. 5,978,672, issued November 2, 1999, and pending U.S. patent application serial number 08/852,951, filed May 8, 1997, both entitled MOBILITY EXTENDED TELEPHONE APPLICATION PROGRAMMING INTERFACE AND METHOD OF USE and hereby incorporated by reference herein, disclose systems and methods for interconnecting a computer network and a wireless network, thereby allowing calls to be terminated on either network. The disclosed systems allow the applications processor to appear as an extension of the wireless network, such as MSC or other network node. Using the system

and methods disclosed in the 5,978,672 patent, Applications Processor 112 and VoIP Gateway 113 may appear as an MSC to the wireless network. Applications Processor 112 functions as an interface by converting and reformatting messages between VoIP Gateway 113 and the wireless network. For example, Applications Processor 112 may
5 convert IS-41 messages from Control Network 106 to IP messages that can be processed by VoIP Gateway 113. VoIP Gateway 113 can also communicate with other devices through connections to PSTN 101 and Internet 111.

A number of edge devices, such as Web TV device 108, may be connected to Internet 111. The term edge device in this context refers to a device on the edge or end of
10 an IP network, Internet, Asynchronous Transfer Mode (ATM) network, Ethernet network or other legacy type of network. The edge device can pass packets between the legacy network and other devices or networks. Edge devices may include Internet appliances, Personal Computers (PCs), and the like. Using a short haul radio system, like Bluetooth or HomeRF, edge device 108 may connect to other devices, such as portable computer
15 114, PDAs, wireless telephone 105, cordless telephones, other Internet appliances, and the like. The short haul radio systems allow these devices to access the Internet or IP network through a wireless connection by establishing a piconet or other relatively short-range wireless network that allows the devices to share data. The edge device communicates with one or more other devices via links 110.

20 In an exemplary embodiment, wireless telephone 105 is equipped with a short haul radio capability, for example, the Bluetooth technology, in addition to the capability to communicate with a conventional wireless telephone network, such as a GSM, DAMPS or IS-95 network. Wireless telephone 105 may also have the capability to communicate with future wireless networks, such a third generation networks or
25 Enhanced Data Rates for GSM Environment (EDGE) networks.

Preferably, the short haul or Blue tooth technology is integrated into wireless telephone 105 so that the handset can detect an edge device when it is within range. For example, wireless telephone 105 may detect inquiry protocol messages or access protocol messages from WebTV edge device 108 when the user is at home or near device 108.

Prior to detection of an edge device, wireless telephone 105 is in communication with the wireless telephone network via link 109 to base station 104. Upon detection of edge device 108, wireless telephone 105 powers down link 109 and establishes link 110 with edge device 108. The order and timing in which link 109 is terminated and link 110 is established is pertinent to the present invention. In an alternative embodiment, wireless telephone 105 may not be currently registered with the wireless network or control network 106 or wireless telephone 105 may not be in communication with base station 103 when edge device 108 is detected. For example, wireless device 105 may be roaming, searching for service, or in a building so that link 109 cannot be maintained due to range or environmental conditions; or wireless telephone 105 may be initializing after being turned on. Although device 105 has been referred to as a wireless telephone in the present example, it will be understood by those skilled in the art that the present system and methods can also be applied to other wireless devices, such as modems, pagers, PDAs, and the like.

When wireless telephone 105 powers down link 109 in favor of link 110, it has effectively de-registered from the wireless network. Therefore, the wireless network does not have information on how to route calls to wireless telephone 105. Edge device 108 is equipped with short haul radio capability and communicates with wireless device 105 to authorize and establish a valid connection. Once connection 110 is established, a signal is sent from edge device 108 to application processor 112, which recognizes the existence of an authorized wireless telephone. Applications processor 112 causes registration messages to be sent through switch control network 106 to HLR 107 and re-registers wireless telephone 105 with the wireless network as described in U.S. Patent No. 5,978,672. Application Processor 112 and VoIP Gateway 113 may appear as an MSC to HLR 107 and the wireless network during this registration process. Calls to wireless telephone 105 can be completed once the device has reregistered via Applications Processor 112.

Once wireless telephone 105 has been registered with the wireless network at edge device 108, calls to the Mobile Directory Number (MDN), or published telephone number for wireless telephone 105, are directed to VoIP Gateway 113 through the interaction of

Application Processor 112 and the wireless network. VoIP Gateway 113 sends the call to wireless telephone 105 through Internet 111 and edge device 108. The call may be set up using techniques described in pending U.S. patent application serial number 09/154,977, entitled DATA NETWORK COMPUTING DEVICE CALL PROCESSING, filed September 17, 1998, the disclosure of which is hereby incorporated by reference herein.

Calls initiated by wireless telephone 105 are transmitted through VoIP Gateway 113 to PSTN network 101. If the mobile dials a normal PSTN call, the call may be routed directly to PSTN 101 from VoIP Gateway 113. If the dialed digits represent something other than a call origination message or telephone number, then VoIP Gateway 113 and Applications Processor 112 will decode the dialed digits and formulate a suitable message for control network 106. For example, if the dialed digits correspond to a feature request, VoIP 113 and Applications Processor 112 recognize the feature request message, convert the message from the IP format received via Internet 111 to an IS-41 format, and route it to the correct wireless network element or node via control network 106 for processing. Any response to the feature request message or returned values from the wireless network can be interpreted by Application Processor 112 and the requested feature or call processing service can be implemented.

In another embodiment of the invention, edge device 108 is connected by a link (not shown) directly to MSC 103. In this embodiment, edge device 108 appears like another base station. MSC 103 may implement the logic contained in Application Processor 112 and VoIP Gateway 113 to register wireless telephone 105 on the short haul network and to route calls to and from device 105.

Although, the edge device has been illustrated in Figure 1 as WebTV device 108, other Internet appliances in the home, business or other establishment may be used. The edge device can be any computer or data device on any computer network including enterprise networks.

The use of the short haul radio detection allows wireless users to be detected when they are near an edge device. This enhances existing wireless networks by allowing positive control over the "in office" or "out of office" states defined in the 5,978,672 patent. When the mobile is close to the edge device, the mobile will register using the short haul radio system. The device is registered on the wireless network HLR as "in office" or "at home" as appropriate and calls can be rerouted by the application processor to an office telephone or home telephone. If the wireless telephone is away from the edge device, the application processor can reroute calls that are directed to an office telephone to the wireless device.

For example, Figure 2 illustrates a system in which the present invention can be used to route calls to the appropriate wireless or wireline telephone or other device. The subscriber has a wireless telephone 201, which travels with the subscriber from home (201a), to work (201b) and to other places within a home or roaming wireless network (201c). Wireless network 202 may be the subscriber's home network or a roaming network. The subscriber's telephone 201c communicates with wireless network 202 through base stations 203 and 204 and MSC 205 using well known methods. A database in HLR 206 tracks the current location of wireless device 201c so that incoming calls to telephone 201c can be routed to the currently serving MSC 205.

In addition to routing calls to and from wireless telephone 201c through PSTN 207, calls may also be routed to other wireless subscribers (not shown) via wireless network 202 or to other devices via Internet 208. Wireless device 201 may receive voice or data calls. Voice calls may be routed over Internet 208 using VoIP technology. Applications Processor/Gateway Server 209 functions as an interface between wireless network 202 and other computer networks.

At the subscriber's home, he may have a short haul radio capable edge device, such as WebTV 210. When the user is at home, WebTV 210 edge device and wireless telephone 201a detect each other. Upon detecting the home-based short haul network, wireless telephone 201a powers down its link with wireless network 202 and re-registers with the wireless network through edge device 210, as described above. When wireless

device 201a re-registers via the short haul network, Applications Processor/Gateway 209 receives a message of this registration from the edge device that is directly communicating to telephone 201 and translates this message into a normal wireless registration message expected by HLR 206. The HLR then updates its location information such that the mobile is now registered to Gateway Server 209. Applications Processor/Gateway 209 will function as an MSC in relation to the wireless network for this feature and the current Internet 208 location of wireless device 201 or the edge device serving 201 may be maintained in a database in Processor 209 allowing it to act as the HLR for the mobile in the Internet 208. Alternatively, the logic and functionality of Applications Processor/Gateway 209 may be incorporated into some other wireless network node or device.

When the subscriber is registered on the short haul network, calls to wireless telephone 201a may be routed in different ways. In one embodiment, calls to wireless device 201 are routed via Internet 207 and the short haul network directly to telephone 201a. In another embodiment, when wireless device 201 is registered on the short haul network, calls to telephone 201 may be routed to fixed wireline telephone 211 instead of to wireless device 201a. The actual call routing selection may be based upon network demands and capabilities or upon a user configured profile. For example, if edge device 210 is unable to stream voice packets to wireless telephone 201a or if traffic Internet 208 is congested or unreliable, then calls may be redirected to telephone 211. Alternatively, HLR 206 or Processor 209 may maintain a user profile that directs wireless calls to home telephone 211 when device 201a is registered on the short haul network.

The subscriber's office or work place may also employ a short haul radio system. An edge device, such as PC 212, is in communication with other devices over the office-based short haul radio system. When the subscriber and wireless telephone 201b are at the work place, edge device 212 and telephone 201b detect each other. Again, as described above, wireless telephone 201b shuts down any existing connections with wireless network 202 and establishes a connection to the office short haul network. Furthermore, wireless device de-registers the original wireless link with wireless network 202, if necessary, and re-registers with network 202 through Applications

Processor/Gateway Server 209. Based upon network capabilities and/or user profiles, calls to wireless device 201 may be routed to telephone 201b through the office short haul network via device 212 and Internet 208. Alternatively, while telephone 201b is registered with the office short haul network, calls to the telephone number for device 201
5 may be routed to office telephone 213.

When wireless device 201c leaves the home or office (or moves too far from edge device 210 or 212), the connection between device 201 and the short haul network is broken. Unless wireless telephone 201c detects another short haul network, it begins to search for standard wireless network 202 in the normal manner. When a connection to
10 wireless network 202 is reestablished, HLR 206 and/or Processor 209 update wireless telephone 201c's current location. Future calls to device 201's telephone number will then be routed to wireless telephone 201c via the wireless network.

In one embodiment, wireless device 201 can arbitrarily shut down the connection in favor of the other. Alternatively, it can conduct a courtesy switchover whereby the
15 existing connection is maintained until the connection is terminated by the user or data application in the case of data transmission. After the connection is terminated and before another is initiated, wireless device 201 connects to the preferred network. In yet another embodiment, the connection can be switched or handed off to the other network without disconnection.

It will be understood by those skilled in the art that the present invention will also be operable with a short haul network that uses Infrared signaling to maintain voice or data connections between devices. The wireless device can be equipped with appropriate Infrared capabilities to communicate with the system. It will also be understood that
20 reference to the "Internet" also includes private packet networks, or public packet
25 networks specifically designed for voice transmission.

In another embodiment of the invention, a series of edge devices can be arranged to provide effective coverage to a larger area than that of a single short haul radio receiver. The wireless device will connect to the closest short haul receiver. If the

wireless device moves to another receiver's coverage area, the communications will be switched over to the second receiver using techniques well known in the art of wireless handoffs. It will be understood that such handoffs may be accomplished between different types of short haul networks, such as a HomeRF to Bluetooth or Bluetooth to
5 Infrared handoff, depending only upon the systems incorporated into the wireless device.

Since the wireless device registers on the short haul network only when it is near an edge device, the application processor can be configured to track the location of the wireless device based upon the active edge device. Furthermore, the applications processor maybe configured to deliver services or information to the user based on the
10 wireless devices current location. Current user location information may also be provided to other entities and third parties.

The edge device and the wireless device can be configured to only notify each other of their presence. In this configuration, the wireless telephone does not power down from the wireless network, but simply sends a reference notification to the edge device.
15 This can be forwarded to the applications processor or the wireless network to serve as a specific location detection. This would allow the application processor or other device to deliver services or information to the wireless telephone via the normal wireless network. For example, short haul radio edge devices can be placed along roads, sidewalks, or in shopping malls. When the wireless device travels past an edge device, location-specific
20 services and information, such as local traffic information or sales information, can be provided directly to the mobile. This information may be sent as a voice call, such as a prerecorded message, or a Short Message Service (SMS) text message that is displayed to the user on the wireless telephone.

Figure 3 illustrates the messages that may be exchanged in the system of Figure 1
25 to set up an outgoing voice call from wireless device 105 via the short haul network. Wireless telephone 105 first establishes a connection with edge device 108 using the appropriate short haul network protocol messages 301. Edge device 108 converts the setup messages and routes the messages 302 to VoIP Gateway 113 over the Internet or packet network. VoIP Gateway 113 then converts the messages as necessary and routes

the setup messages 303 either to PSTN 101 or to the wireless network through Applications Processor 112. Typically, message 302 is sent in a packet format across the Internet. The format of message 303 may be an IS-41 format to be routed to the wireless network or an INAP format to be routed to the PSTN. Once a voice circuit has been established, the voice call 304 is routed from wireless telephone 105 to the called destination via edge device 108 and VoIP Gateway 113.

Figure 4 illustrates messages exchanged to establish an incoming call to wireless device 105 in the present invention. Wireless telephone 105 detects edge device 108, the short haul radio system, and registers on the short haul network with messages 401. Edge device 108 sends registration message 402 to Applications Processor 112 in a TCP/IP format via Internet 111 or via another computer network. Application Processor 112 sends message 403 to HLR 107 and updates the registration information for device 105.

The MIN for wireless telephone 105 is assigned to a particular service provider's wireless network or MSC 102. For incoming calls 404 to telephone 105, call setup messages are directed to the home wireless network to request routing instructions. The device's home network is queried for routing information no matter where telephone 105 is actually located. In Figure 4, incoming call 404 for device 105 is first routed to home MSC 102, which queries HLR 107 (by message 405) for routing information. Since HLR 107 knows that wireless 105 telephone is currently registered on a short haul network, HLR 107 sends location request message 406 to Applications Processor 112. In response, Applications Processor 112 returns location request response 408 to HLR 107 and sends resource setup message 407 to VoIP Gateway 113.

The location request return result message 408 includes a Temporary Local Directory Number (TLDN) that identifies the channel that is set up to VoIP Gateway 113 by message 407. This TLDN is sent to MSC 102 in route request return result message 409. MSC 102 uses this information to complete a call connection to telephone 105 for call 404. The voice call is routed from MSC 102 to VoIP Gateway 113 as connection 410. Message 410 includes the previously selected TLDN, which is used by VoIP Gateway 113 to route the call to the correct wireless telephone. VoIP Gateway 113

converts the incoming voice call 410 to packet data 411 that is routed to edge device 108, which then converts the packets to the short haul radio format and sends it to telephone 105 in wireless message 412.

Figure 5 illustrates messages that are exchanged in the present system when the called wireless telephone is busy. When wireless telephone 105 is active on the short haul network, all calls or other communications will be routed through a VoIP Gateway, such as 113. Therefore, whenever wireless telephone 105 is on a voice call, such as an incoming or outgoing telephone call, or on a data call, such as an Internet access connection, VoIP 113 is used in the connection (501) and will be aware that wireless telephone 105 is busy. Alternatively, if VoIP Gateway 113 is not directly part of the voice or data connection, wireless device 105 may send a message 501 to VoIP Gateway 113 to indicate a busy state.

Incoming calls 502, like incoming call 404, are routed to the home MSC 102 for the wireless telephone's MIN. MSC 102 sends route request message 503 to HLR 107. Knowing that wireless telephone 105 is registered on the short haul network, HLR 107 in turn sends location request 504 to Applications Server 112, which sends resource setup message 505 to VoIP Gateway 113. Since VoIP Gateway 113 is aware that telephone 105 is busy, it returns device-busy setup return message 506.

Messages 503, 504, 505 basically correspond to messages 405, 406, 407, respectively, from the previous example in Figure 4. In this example, MSC 102, HLR 107 and Applications Server 112 do not know if wireless device is currently free or busy. Therefore, incoming calls to wireless telephone 105 are setup as normal until they reach a device, such as VoIP Gateway 113 in this example, that knows whether device 105 is busy. In other embodiments, MSC 102, HLR 107 or Applications Server 112 may monitor the current busy status of wireless telephone 105 and one of these components may return a device-busy message.

Applications Server 112 sends location request redirection message 507 to HLR 107 to indicate that wireless telephone 105 is not available to accept the call. HLR 107 determines whether the incoming call should be redirected to some other destination, such as another telephone number, a voice mail system, or the like, and returns route request
5 return message 508 to home MSC 102 with a redirection number for the appropriate destination. MSC 102 then completes the call connection to the destination and establishes a voice circuit 509 to the alternate destination for incoming call 502.

If wireless telephone 105 is capable of using a call waiting feature or can receive Calling Line ID (CLID) information, then VoIP 113 may send a call waiting message 510
10 to wireless telephone 105 to notify the user of a second call. Message 510 may include CLID information to indicate who is waiting on the second call. If the user desires to accept the second call, message 511 is returned to VoIP Gateway 113 indicating the second call should be connected to telephone 105. Following receipt of message 511, VoIP Gateway 113 causes a call connection to be completed as described above for
15 messages 408 to 412. Otherwise, if the user rejects the second call by not returning message 511 within a certain time, VoIP Gateway will return busy message 506 to Applications Server 112 indicating that the user is not available and the call will either be redirected or the caller will receive a busy indication.

Although the present invention and its advantages have been described in detail, it
20 should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary
25 skill in the art will readily appreciate from the disclosure of the present invention, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are

intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

WHAT IS CLAIMED IS:

We claim:

1. A method for providing wireless communications to a wireless device that is capable of communicating with both a wireless network and a short haul network, comprising the steps of:
 - detecting, by the wireless device, an edge device in a short haul radio network;
 - 5 establishing a communications link between the wireless device and the short haul network;
 - terminating existing communications links between the wireless device and the wireless network; and
 - registering the wireless device with the wireless network as active on the short
 - 10 haul network through an applications processor that couples the short haul network to the wireless network
2. The method of claim 1 wherein said short haul network is a network complying with a Bluetooth protocol and wherein the wireless device is coupled to the edge device using the Bluetooth protocol.
3. The method of claim 1 further comprising the step of:
 - determining when the communications link between the wireless device and the short haul network is terminated;
 - establishing a communications link between the wireless device and the wireless network; and
 - registering the wireless device with the wireless network as active on the wireless network.
4. The method of claim 1 wherein the edge device is a personal computer.
5. The method of claim 1 wherein the edge device is a WebTV device.
6. The method of claim 1 wherein the edge device is an Internet or computer network device or appliance.

7. The method of claim 1 further comprising the steps of:
receiving call setup messages from the wireless network for calls directed to the
wireless device; and
establishing a call connection between the wireless network and the wireless
5 device.

8. The method of claim 1 further comprising the steps of:
receiving call setup messages for calls initiated by the wireless device on the short
haul network; and
establishing a call connection between the wireless network and the wireless
5 device.

9. A system for coupling a computer network to a wireless network, wherein
the computer network is coupled to a short haul radio network, the system comprising:
means for receiving registration messages from the short haul radio network, said
registration messages received via the computer network and having a format adapted for
5 transmission over the computer network;
means for converting the registration messages to a format adapted for the
wireless network; and
means for sending the converted registration messages to the wireless network.

10. The system of claim 9 further comprising:
means for establishing a voice call connection between the wireless network and
wireless devices that are active on the short haul radio network; and
means for converting voice communication signals on said wireless network to a
5 format that can be transmitted across said computer network to said short haul network.

11. The system of claim 9 wherein said means for converting registration
messages converts packet-based messages on the computer network to IS-41 messages on
the wireless network.

12. The system of claim 9 wherein said means for converting registration messages converts packet-based messages on the computer network to Intelligent Network Application Protocol (INAP) messages on the Public Switched Telephone Network (PSTN).

13. The system of claim 10 wherein said means for converting voice communications signals converts between Pulse Code Modulation (PCM) signals on said wireless network and packet-based signals on said computer network and then to the format used by the short haul radio.

14. The system of claim 10 wherein said means for converting voice communications signals converts between a packetized voice format used by the wireless telephone and the packet-based signals on said computer network.

15. The system of claim 10 wherein said means for converting voice communications signals does no conversion and encapsulates the message for transmission through the computer network and short haul radio link to the wireless telephone.

16. The system of claim 10 wherein no conversion is required and the signal is transmitted directly to the wireless telephone.

17. The system of claim 11 wherein said packet-based signals are Voice over Internet Protocol (VoIP) signals.

18. The system of claim 9 further comprising:

means for communicating with a Home Location Register (HLR) for a wireless telephone that is registered on the short haul radio network.

19. The system of claims 18 wherein said means for communicating with an HLR further comprises:

means for updating a current location of said wireless telephone.

20. The system of claim 9 further comprising:

means for connecting the computer network to the wireless network as a functional entity of the wireless network, thereby enabling the wireless network to interact with the computer network and to provide local mobility and profile information to the computer network.

21. The system of claim 20 wherein the means for connecting the computer network to the wireless network operates to allow the computer network to function as a Mobile Switching Center (MSC) on the wireless network.

22. An apparatus for integrating a wireless network to a computer network, the wireless network having a protocol to facilitate interaction among network elements and for providing enhanced and customized services to wireless devices, the computer network having a protocol for facilitating the transmission of signals across said computer network, the apparatus comprising:

means for translating signals from the wireless network protocol to the computer network protocol; and

means for translating signals from the computer network protocol to the wireless network protocol;

means for exchanging messages with said wireless network; and

means for exchanging messages with wireless devices that are active on a short haul radio network extension of said computer network.

23. The apparatus of claim 22 wherein said wireless network protocol is an IS-41 protocol and said computer network protocol is a packet-based protocol.

24. The apparatus of claim 22 wherein said wireless network protocol is an Intelligent Network Application Protocol (INAP) protocol and said computer network protocol is a packet-based protocol.

25. The apparatus of claim 22 wherein said translating means and said receiving means cooperatively function to receive registration messages from said wireless devices active on said short haul radio network and to translate said registration messages to registration messages on said wireless network.

26. The apparatus of claim 25 wherein said wireless devices active on said short haul network register with a Home Location Register (HLR) on said wireless network.

27. The apparatus of claim 22 further comprising:
means for establishing a call connection between said wireless telephones active on said short haul radio network and said wireless network.

28. The apparatus of claim 27 further comprising:
a voice over internet protocol gateway for converting between voice signals on said wireless network and packet-based voice signals on said computer network.

29. A wireless device that is capable of communicating with both a wireless network and a short haul radio network comprising:

means for establishing a communications link with and registering on the wireless network;

5 means for establishing a communications link with and registering on the short haul radio network; and

means for detecting short haul radio network edge devices while registered on said wireless network.

30. The wireless device of claim 29 further comprising:
means for sending registration messages to the wireless network when a communications link is established between the wireless device and the short haul network.

31. The wireless device of claim 29 further comprising:
means for maintaining a communications link with the wireless network while sending registration messages over said short haul radio network, wherein said registration messages on said short haul radio network update the wireless device's
5 location in a database on said wireless network.

32. The wireless device of claim 29 further comprising:

means for detecting a second short haul radio network while in communication with a first short haul radio network; and

means for completing a handoff between said first and second short haul
5 networks.

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FIG. 1

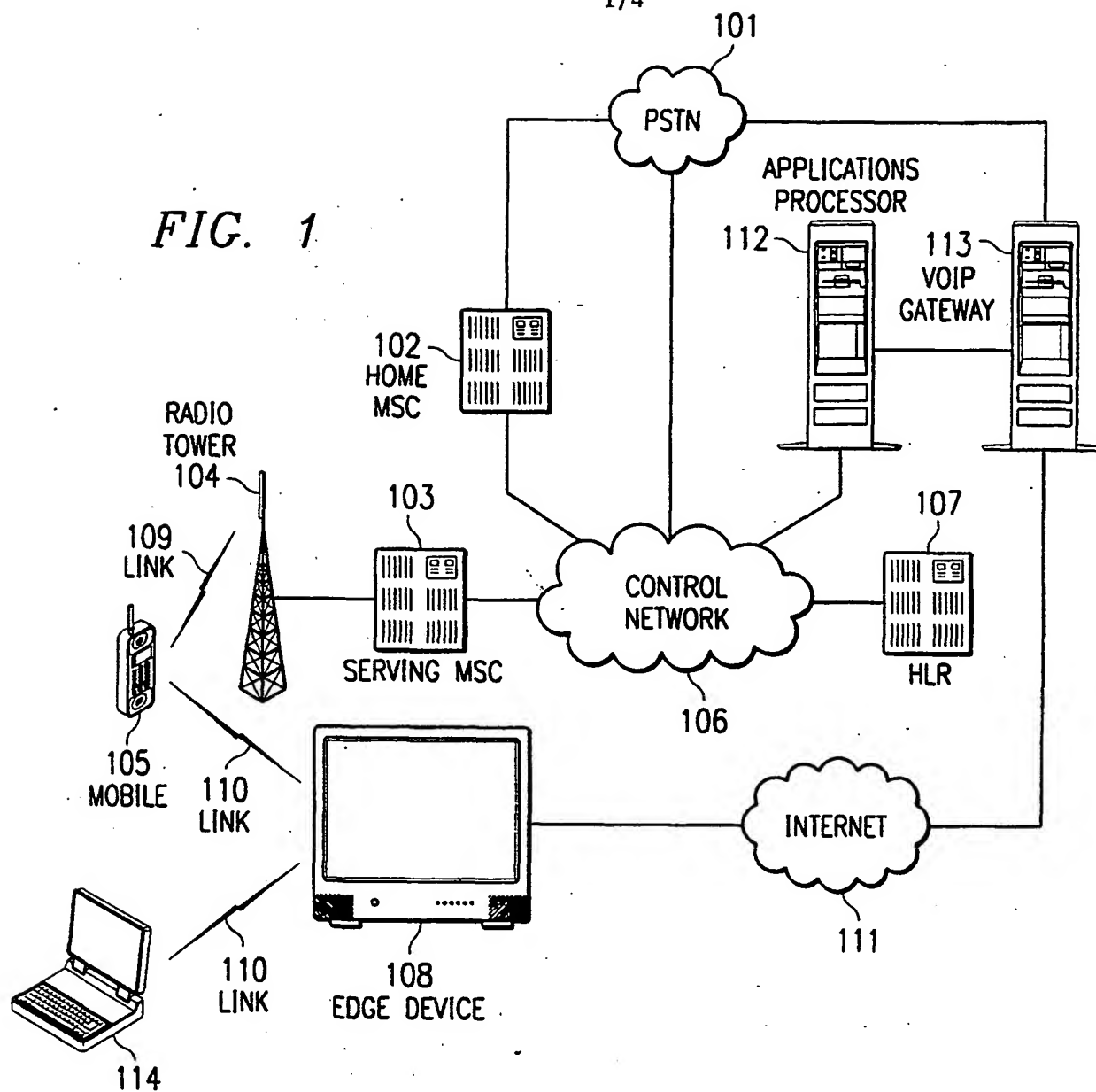
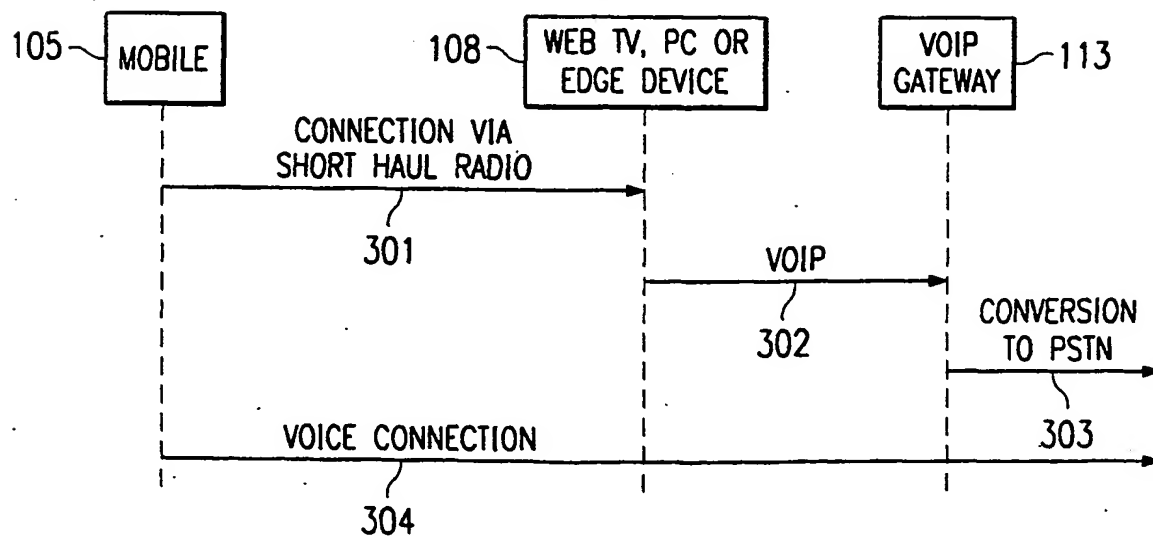


FIG. 3



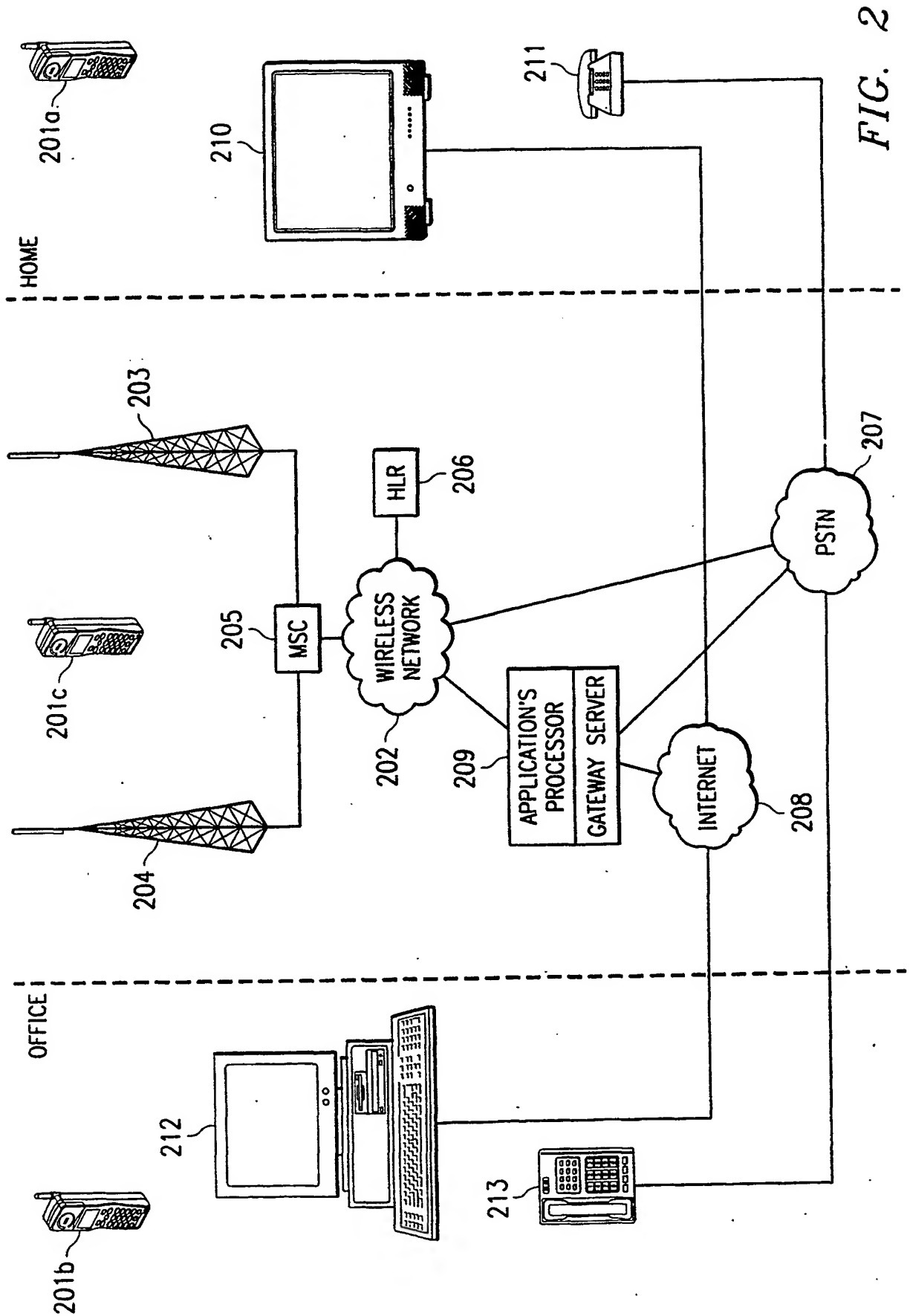


FIG. 2

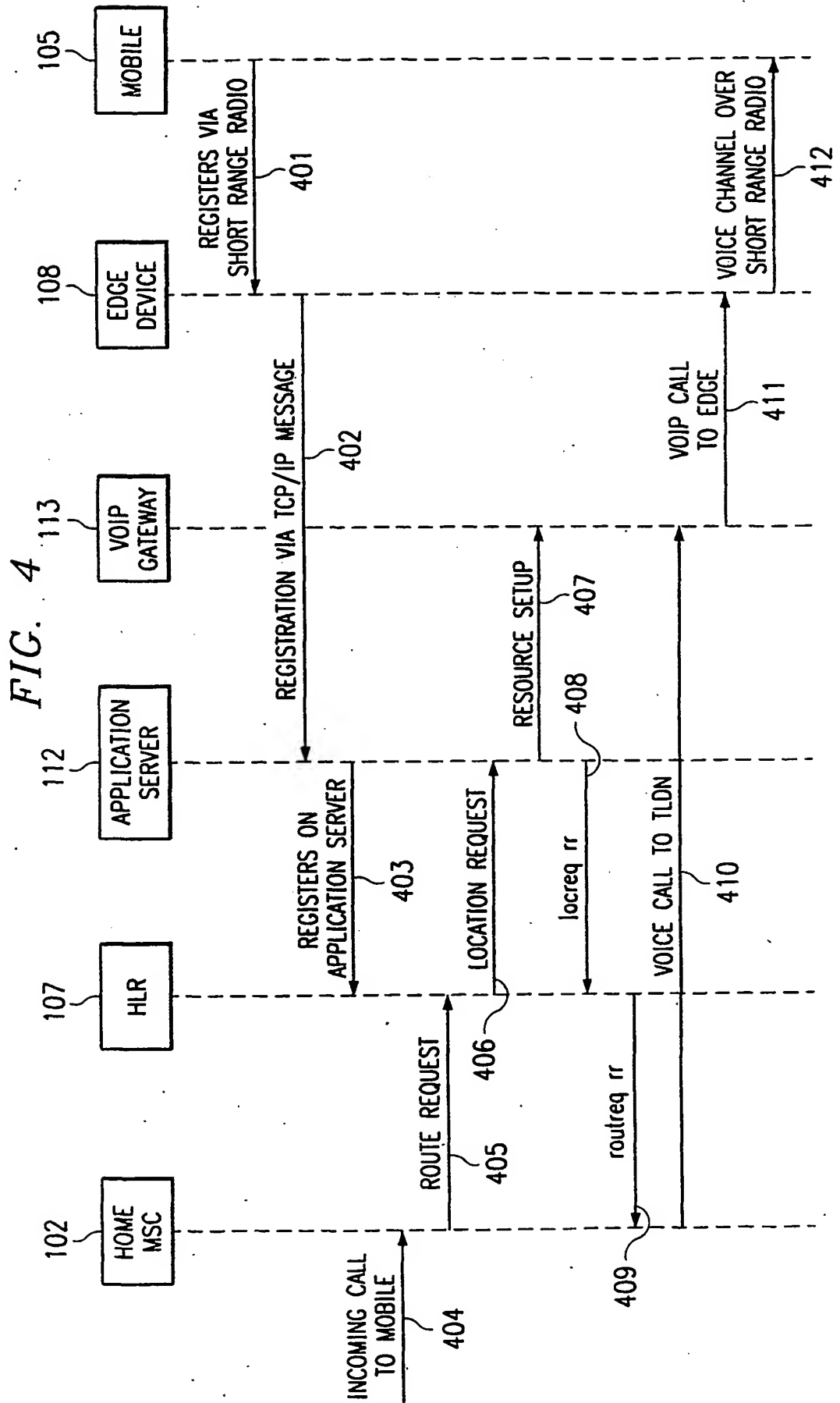
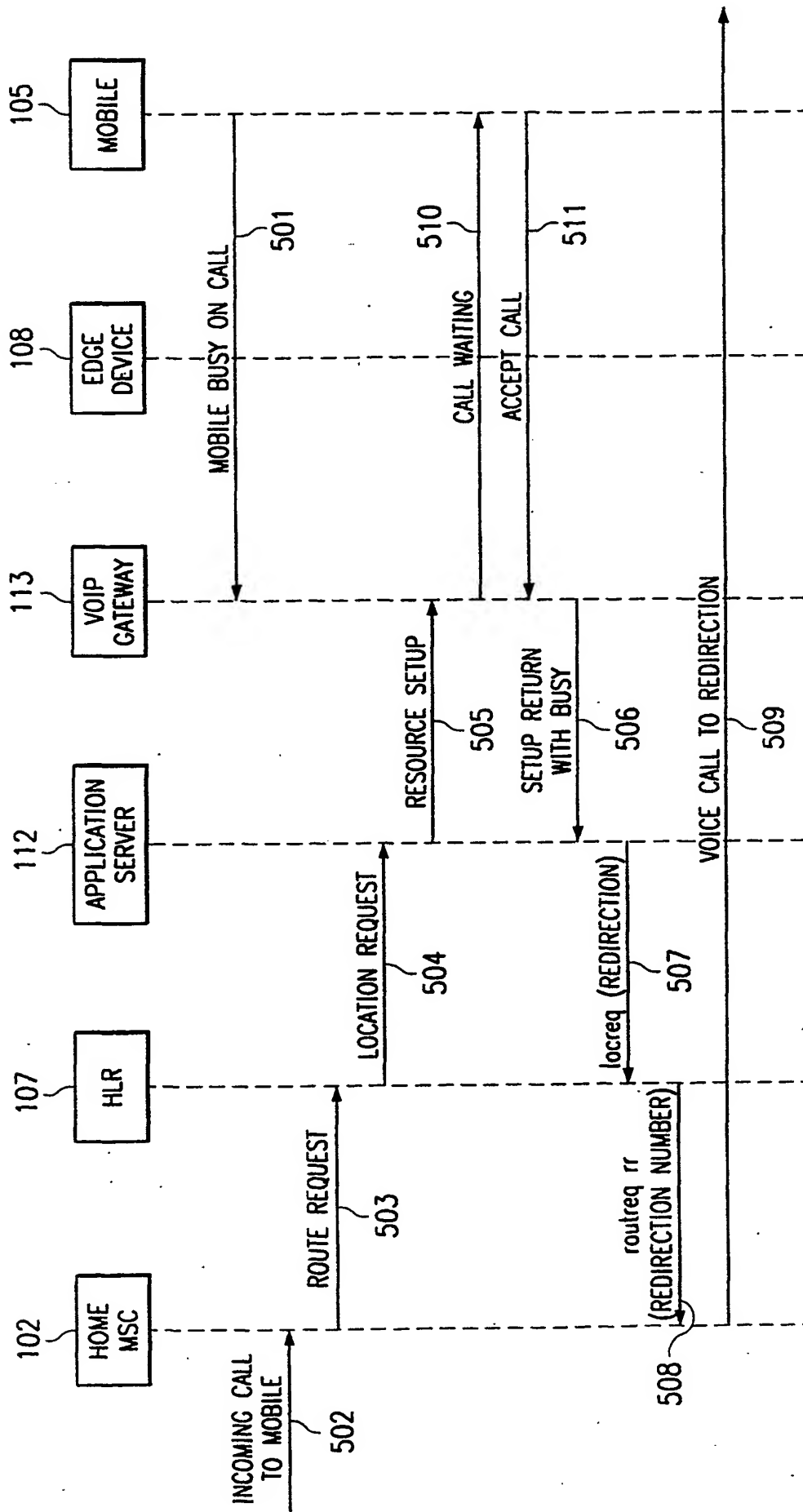


FIG. 5



(19) World Intellectual Property Organization
International Bureau



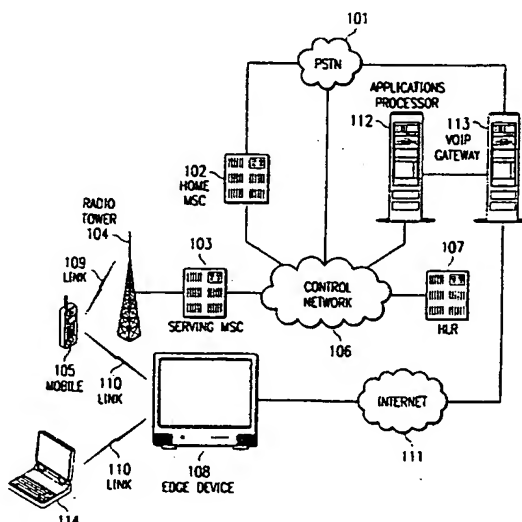
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(54) Title: **SHORT HAUL RADIO SUPPORTED WIRELESS COMMUNICATIONS**



(57) Abstract: A system that allows wireless devices, such as mobile phones (105), pagers or PDAs, equipped with short haul radio in addition to normal cellular or PCS frequencies to register, originate and receive calls through a computer network or the Internet. Short haul radio systems may use Bluetooth or HomeRF protocols. When the wireless device comes within range of an edge device (108) in the short haul network, the wireless device detects the presence of the edge device and switches to the frequencies used by the short haul system. The edge device converts signals from the short haul radio to a format compatible with the computer network. An application processor (112) on the computer network interfaces with the wireless network's signaling and control network to allow the mobile to register on the wireless network. Incoming calls to the mobile are then under the control of the application processor, which causes calls to be routed to the edge device through an associated gateway (113). Outgoing calls are routed through the edge device to the gateway into the PSTN (101).

INTERNATIONAL SEARCH REPORT

Intern. Application No

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A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04L12/28 H04L12/56 H04Q7/38 H04M7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	<p>EP 0 928 120 A (SIEMENS AG) 7 July 1999 (1999-07-07)</p> <p>column 1, line 1 - line 53 column 2, line 17 - line 49 column 3, line 53 -column 4, line 12 column 5, line 19 - line 25 column 6, line 5 -column 7, line 39 column 8, line 22 - line 45 column 11, line 58 -column 12, line 8</p>	<p>1,3, 7-10,16, 18,19, 22, 24-27, 29-31</p>
A	<p>WO 99 29126 A (JOERESSEN OLAF J ;NOKIA MOBILE PHONES LTD (FI)) 10 June 1999 (1999-06-10) page 1, line 25 -page 2, line 14</p>	<p>2</p>

INTERNATIONAL SEARCH REPORT

Information on patent family members

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